of this superiority as "mainly due to superior evaporation in the water hemisphere generally," it did not occur to me that I could be misunderstood to mean that the excessive depression in high south latitudes is due to excessive evaporation taking place *within those latitudes*, an idea which, with Mr. Murphy, I regard as absurd.

The large areas of depression which the American meteorologists have termed the "Polar Cyclones" appear, on examination, to be themselves aggregates of those local depressions, or cyclones, which have penetrated either into the Arctic or Antarctic regions, and have there, either partially or wholly, coalesced. Local depressions starting from the edges of the great areas of excessive evaporation seem to be governed in their course by the distribution of relative humidity, and to be determined towards those districts in which precipitation is most in excess of evaporation. Consequently their forward development is, as a general rule—a rule to which there are in the northern hemisphere many important exceptions—somewhat towards the poles. As they advance between converging longitudes they commonly expand, and therefore become united, while the influence of the earth's rotation deflects their circulating currents further away from the points of lowest pressure. Mr. Murphy's view that the imperfection of the Arctic as compared with the Antarctic depression, is due to the amount of land in the northern hemisphere, and the local air-currents produced thereby, is not in opposition to my argument. Undoubtedly over Greenland the anticyclonic circulations predominate (except in the summer quarter) over the cyclonic. It is not improbable that somewhat analogous irregularities of pressure dependent on the distribution of land and sea may exist in high south latitudes. But I still think that it is to the middle latitudes of the two hemispheres that we must look in order to find the chief cause of the contrast between the Antarctic and Arctic depressions, for it is in the middle latitudes that the majority of the local depressions originate. In the southern hemisphere those latitudes are almost entirely occupied by surfaces in which evaporation is excessive. In the northern they are represented to a large extent by areas of relatively slight evaporation and predominant precipitation.

The correlation of wind and pressure-distribution is of a kind which can hardly be stated at the same time briefly and correctly. But if it is necessary to be concise, it seems more natural in every case to regard the distribution of pressure as the primary cause of the wind than to say "the cause of the depression round the Pole is the centrifugal force of the west winds."

Lutterworth, January 9 W. CLEMENT LEY

Sense of Hearing, &c., in Birds and Insects

MR. ROMANES (NATURE, vol. xv., p. 177) is not quite correct in supposing that the Death's Head is the only species of *Lepidoptera* known to "stridulate." Possibly the phenomenon is far more general than is commonly believed, although only few instances of its occurrence have been observed. In the current number of the *Entomologist's Monthly Magazine*, Mr. Swinton details the method in which a sound is believed to be produced by *Vanessa io* and *V. urticæ*, viz., by friction of a nervure of the hind-wings against a "filed" nervure in the fore-wings. *Chelonia pudica*, one of the tiger-moths, has long been known to produce a sound (*cf.* Solier, *Annales Soc. Entomol. de France*, 1837). In 1864, Guenée (*Ann. Soc. Fr.*, pp. 398–401) notices that the genus *Setina* possesses a tympaniform organ on each side of the breast, analogous to that found in the *Chelonia*, and in the same volume he is followed by Laboulbène, who gives an elaborate anatomical description of the organ in *Chelonia*, with figures (pl. 10). Another tiger-moth (*Euprepia matronula*) is said to stridulate (*cf.* Czerny, *Verhand. zool.-bot. Vereins in Wien*, 1859); and the existence of the phenomenon is (at least) suspected in members of other groups of *Lepidoptera*.

Without being able to prove it, I suspect that birds obtain a knowledge of the whereabouts of worms and subterranean larvæ by sight, and not by sound. In the case of the thrush, I think the excrement rejected to the surface guides the bird to the right spot. The starling during breeding-time feeds almost exclusively on the larvæ of *Tipula*. Here, again, I think it is sight, and not sound that aids the bird. True, in this case there is no rejected excrement on the surface, but there is something that may be equally significant to the eye of the bird, viz., the withered condition of the plants of grass, &c., telling a tale of the mischief that is going on below. Furthermore, is it not possible that if the movements of the larvæ below the surface cause sufficient *sound* to be heard above the surface, the movements of the bird should act as a warning, and cause the larvæ to cease feeding? The withered plant tells its own tale; if only flagging, but yet with some amount of vitality in it, the chances are that a larva is still at work at its roots; if entirely dead, then the larva has departed for another plant.

Confessedly in the case of the curlew and allied birds, the matter becomes very difficult of explanation, owing to the depth below the surface at which the food is found. But do these marine and other worms always keep at the depth to which the bird is obliged to penetrate in order to obtain them? *Solen* is believed to remain near the surface until warned that an enemy is near, when it descends with rapidity. The worm might also be ordinarily near the surface, and the slight movement thereon caused by its endeavours to bury itself deeper might result in its destruction. I throw this out as a suggestion, because it is hard to believe that sound produced by the movements of an annelid could be transmitted through nearly a foot of sand. There is yet another difficulty. In the case of the curlew the sound would have to travel nearly a foot *above* the surface before it reached the auditory organs of the bird.

Lewisham ROBERT M'LACHLAN

THE "CHALLENGER" COLLECTIONS

THE following "Preamble" to a list of observing stations, printed for the use of the naturalists engaged in preparing the account of the voyage, contains so much likely to interest naturalists generally that we think it useful to publish it in NATURE:—

The special object of the *Challenger* Exploring Expedition was to investigate the physical and biological conditions of the great ocean basins; and with this object in view, during an absence from England of three years and a half, and at intervals as nearly uniform as circumstances would permit, throughout a course of 68,890 miles, 362 observing stations were established.

The following list of these stations has been compiled for the use of those naturalists who have consented to assist in the working out of the scientific results of the expedition, with a view to their being published in an official account of the voyage. Interesting observations were made on land as opportunity occurred during the short periods of the *Challenger's* stay in port, and during her short visits to remote islands; but these observations were necessarily desultory and incomplete, and it has been decided to omit their consideration from the present work, and to publish such as may appear of sufficient value in the transactions of learned societies. The Official Report will thus consist strictly of an account of the additions which have been made to the knowledge of the physical and biological conditions of the ocean by the expedition.

At each station the following observations were made, so far as circumstances would permit. The position of the station having been ascertained—

1. The exact depth was determined.
2. A sample of the bottom averaging from 1 oz. to 1 lb. in weight was recovered by means of the sounding instrument, which was provided with a tube and disengaging weights.
3. A sample of the bottom water was procured for physical and chemical examination.
4. The bottom temperature was determined by a registering thermometer.
5. At most stations a fair sample of the bottom fauna was procured by means of the dredge or trawl.
6. At most stations the fauna of the surface and of intermediate depths was examined by the use of the tow-net variously adjusted.
7. At most stations a series of temperature observations were made at different depths from the surface to the bottom.
8. At many stations samples of sea-water were obtained from different depths.
9. In all cases atmospheric and other meteorological conditions were carefully observed and noted.

10. The surface current was determined as far as possible.

11. At a few stations an attempt was made to ascertain the direction and rate of movement of water at different depths.

The numerical results of observations yielding such are now available in the logs, in the various reports of the Admiralty, and in the note-books and official journals of the naval and civilian scientific officers attached to the expedition.

The samples of the bottom procured by the sounding-instrument were carefully preserved in tubes or in stoppered bottles, either dry; or wet, with the addition of alcohol.

The samples of bottom and intermediate waters were determined as to their specific weight; in some samples the amount of carbonic acid, and in others the amount of chlorine, was determined; in others the contained gases were boiled out and sealed in tubes for future examination; and a large number of samples were reserved in stoppered bottles for analysis.

The mud and minerals and inorganic concretions brought up by the dredge or trawl were preserved in large quantity in boxes or jars for examination and analysis.

The collection of invertebrate animals is of great extent; and from most of the species being undescribed, and from the great peculiarity of the distribution of the fauna of the deep sea, it will perhaps yield the most generally interesting results.

The invertebrate animals from the deep-sea stations were, with few exceptions, placed in jars of rectified spirit, closed with stoppers smeared with a mixture of tallow and wax, covered over with bladder, and the tops painted with a black varnish. The animals of different groups were in many cases roughly selected at each dredging, and put into different jars; but frequently, in order to save jars and spirit, it was necessary to put the whole result of one dredging into one or two jars, the animals of all groups mixed. Each jar was marked outside with the locality and the number of the station; and the station number, written with a black pencil on a slip of parchment, was placed *within* each jar. The collection on its arrival in this country was thus arranged geographically. It came home in most excellent order.

To insure accuracy so far as possible, the observing stations have been numbered from 1 to 354, and a number corresponding to the station is on every sample of every description, and on every record of the result of observations for every station; and the same number is carried through the whole series of journals and other books kept by the members of the Civilian Scientific Staff.

It is now our object, in preparing a scientific account of the voyage, to describe these investigations, and to give their results in detail; and to develop, as far as possible, the bearings of these results upon one another, and upon the broad problems of physical geography and hydrography.

For this purpose it is necessary that the various numerical results should be reduced and tabulated; that the samples of soundings should be examined chemically and microscopically; that the samples of water and of air should be analysed; and that the animals procured by the dredge should be most carefully catalogued as to localities, and the forms new to science described.

The data for the physical and chemical work are in few hands, and these chiefly at head-quarters. It is especially for the assistance of the naturalists dealing with the deep-sea fauna that these notes are drawn up.

Prof. Agassiz, Mr. Murray, and I have now gone over the whole of the collection of marine invertebrate animals in spirit; and we have separated the zoological groups from one another for each station, and re-arranged the collection in zoological order. Each jar, therefore, now contains animals of one group only (*e.g. Ophiurids* or *Alcyonarians*), to be described by one person. Each jar has within it a station number, which refers to the specimens which are loose in the jar; but in many cases, to save space, and to lessen the number of large jars, there are in the same jar several packets done up in muslin, each packet containing animals of the same zoological group from another station, and each packet having within it its own station number.

The jars will be placed in the hands of the naturalists who undertake the description of the different groups in their present condition; and in order to secure uniformity and the safety of the collection, they are requested—

1. To go carefully over the whole collection intrusted to them, and to select a first series, including all unique specimens and a sufficient number of specimens of those of which there are several duplicates, to illustrate their geographical distribution; and to associate with each species a particular number, by which number that species may be always referred to afterwards—at all events, until it has been described and named. This is the collection which is to be described and figured, and it is ultimately to be placed as a collection of types in the British Museum. It will usually be desirable, for the purposes of description and illustration, to put the specimens of the first series into rectified spirit in clear glass bottles; and I will arrange in each case how the bottles are to be provided and the expense defrayed. This collection must be retained by the describer until the description of the whole is finished.

2. To select at the same time a second set, consisting of a complete series of duplicates, numbered to correspond with the numbers attached to the first series species for species, and to pack them either in separate bottles or in packets in muslin, a number of packets together in one store bottle. This set to be returned to me for reference.

3. To pack up again all the duplicates from the different stations, each species from each locality either in a separate bottle or in a muslin packet, with the station number and the number corresponding with the type specimen of the species along with it. It will greatly facilitate matters if this general duplicate collection is returned to me along with the first series of duplicates, whenever the collection has been gone over, and the first series for description selected out.

4. For easy reference, each naturalist who undertakes the working out of a group will be provided with a large number of small vellum labels, marked thus :—

Ast.	(Asteridea.)
St	(Station.)

and he need simply enter, *with a dark pencil*, the number which he has associated with the particular species, and the number of the station where the specimens were found; and put the label *into* the bottle or the muslin bag, as the case may be.

Special arrangements must be made in every individual case as to publication, but it is the general intention that the account of the voyage shall be in a series of volumes quarto, of the size of the *Philosophical Transactions* of the Royal Society. It will probably consist of—

1. Two volumes, containing—(1) such a general account of the voyage, and such hydrographic details, illustrated by charts and sections, as may be necessary for the clear comprehension of the scientific observations; and (2) a full discussion of the general results of the voyage, physical and biological. To these volumes will be appended tables of the routine observations in meteorology, &c., made during the voyage.

2. A volume containing an account of the physical and chemical observations and investigations, with a special discussion thereon. To this volume will be appended tables of analysis, tables of specific gravities, reports on the microscopical examination of minerals, &c.

3. A series of volumes, probably not less than six in number, containing a detailed account of the fauna, and plates illustrating the undescribed or imperfectly known forms.

In case of plates being required, the space available for figures on each plate is not more than 11 by 8½ inches (= 28 by 12·5 centimetres). It is intended that the plates shall be, generally speaking, in lithograph; but if any form of engraving seem preferable in any case, a special arrangement may be made. Woodcuts will be given where required.

I undertake the editing of the work, and all manuscripts and proofs of plates are to be sent to me.

All packages and letters to be addressed—

Professor Sir Wyville Thomson, F.R.S.,
University,
Edinburgh.

and marked "*Challenger.*"

The intention at present is that the preparation of all the volumes shall go on simultaneously, and it is earnestly desired that the different parts may be done as speedily as is consistent with the utmost care and accuracy. Authors are invited to enter into any anatomical or other details which may be desirable for the full illustration of the groups in their hands; and their full consideration is particularly requested of all questions bearing upon geographical distribution, and upon the relation of the deep-sea fauna to the faunæ of the later geological periods.

Authors will be at full liberty to publish abstracts of the results of their work during its progress, in the proceedings of Scientific Societies; but such communications should be made through me or with my knowledge, and "by permission of the Lords Commissioners of the Treasury."

I am directed to report to Government and to furnish my accounts at certain intervals; and in order that I may be able to do so, authors are requested to report progress and to render accounts and vouchers for any expenses which they may have incurred, to me quarterly; on or before the 1st of March, of June, of September, and of December.

In the following list of stations—

1. The number is given by which each particular station is referred to throughout. The first eight stations, to which Roman numerals are attached, are to be considered in a certain sense preliminary; the regular series commences with Station 1 (*bis*) on the 15th of February, 1873, and is indicated by Arabic numbers up to 354.

2. The date is given.

3. The exact position of the ship at noon of the day on which the observations were made.

4. The depth in fathoms (= 6 English feet).

5. An abbreviation, as it is given on the chart, indicating the nature of the bottom:—

r. (rock) indicates hard ground, where nothing was brought up by the sounding instrument, there being at the same time evidence that the tube had reached the bottom.

m. (mud), a material varying in colour, but derived chiefly from the disintegration of the land.

gl. oz. (globigerina ooze), a white or greyish deposit formed in a great measure of the shells, entire or broken, of foraminifera belonging to the genera *Globigerina*, *Orbulina*, *Pulvinulina*, and *Hastigerina*, usually with a quantity of amorphous calcareous or earthy matter, and many coccoliths.

di. oz. (diatom ooze) indicates a deposit formed to a great extent of the frustules of diatoms which have sunk from the surface.

rad. oz. (radiolarian ooze) indicates a deposit composed mainly of the skeletons of Polycystina and other Radiolarians.

r. cl. (red clay) indicates a deposit, very widely extended in deep water, of red, reddish, or grey aluminous mud, such as would be produced by the decomposition of a felspathic mineral. This deposit varies considerably in character; it seems to be derived from several sources, but one of the most important of these appears to be the decomposition of pumice and other volcanic products. The "red clay" often contains concretionary nodules, consisting chiefly of the oxides of manganese and iron.

gr. oz. (grey ooze), and gr. m. (grey mud), usually indicate an intermediate condition between Globigerina ooze and red clay, or in some cases a fine-grained grey deposit, formed in deep water, chiefly of land *débris*.

The positions of the stations are shown on the accompanying chart.

C. WYVILLE THOMSON

Edinburgh, January 2

PROF. AGASSIZ ON THE "CHALLENGER" COLLECTIONS

PROF. AGASSIZ, who has come to this country for the express purpose of examining the *Challenger* Collection, has kindly sent us the following notes on what he has already seen:—

I have seen a great many alcoholic collections of marine animals made by direction of different government expeditions, and in no case have I seen one in a better state of preservation, or where greater care had been taken to insure the accuracy of the locality. Those who work up the material will have the double advantage of working on admirably-preserved collections, and of being absolutely certain of the exact locality of their specimens. Sir Wyville Thomson has already called attention, in his Preliminary Reports to the Royal Society and his Lecture before the British Association at Glasgow, to many of the most interesting things collected, and he has also alluded to the amount of the material brought together. I may perhaps give a better idea of the magnitude of the collections by stating that if a single individual, having the knowledge of the eighteen or twenty specialists into whose hands the collections are to be placed, were to work them up, he would most certainly require from seventy to seventy-five years of hard work to bring out the results which the careful study of the different departments ought to yield.

We may assume that the work of the *Challenger* has probably accomplished for the depths of the ocean in general what the American and English expeditions of 1866–1869 did for the North Atlantic, for it certainly is remarkable how much these expeditions, working over a comparatively limited area, contributed to the knowledge of the deep-sea fauna, and how little of novelty has been added by the subsequent and more extended work of the *Challenger* over the same ground. Judging from these premises, we may fairly say that hereafter, while any new expedition will undoubtedly clear up many of the points left doubtful by the *Challenger*, and may carry out special lines of investigation only partly sketched out, yet we can hardly expect them to do more than fill out the grand outlines laid down by the great English expedition.

To attain the best possible results it is of the utmost importance that the collections brought home should be placed in the hands of specialists who are thorough masters of their respective departments. The scientific public will therefore hear with the greatest satisfaction that the Government has left the collections in the hands of Sir Wyville Thomson, who is to direct the publications until the whole of this invaluable material is thoroughly worked out.